

## Do Contracts Reduce Income Risk?

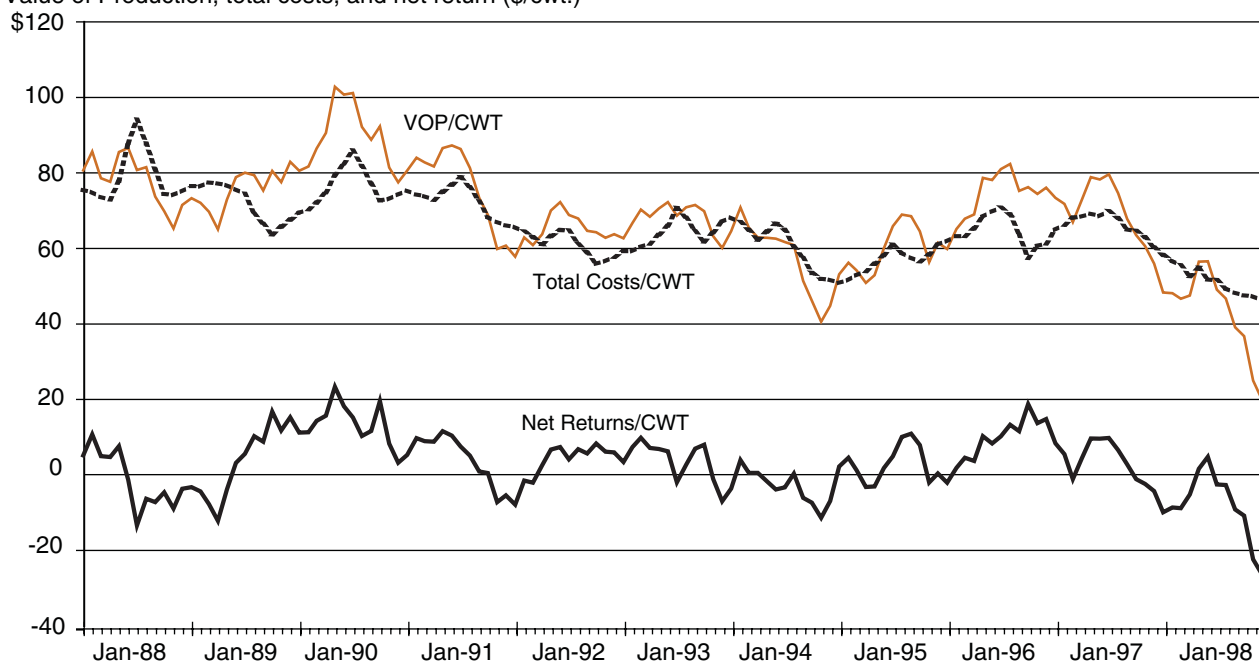
We have highlighted two sources of income risk: yield (or production) and price. Yield risks result from unpredictable events (such as drought for crops, or disease for livestock) that affect the quantity of production. That is, favorable weather may lead to unusually large crops, while bad weather may reduce crop yields or livestock weight gains. Price risks arise from unanticipated changes in output or input prices. Contracts can limit the risks faced by farmers by shifting price and (sometimes) yield risks to market participants who are better positioned to bear them, and in some cases, by controlling and reducing risks. In this section, we describe how contracts can be designed to limit risks and summarize the results of the few studies of the actual effect of contracts on risk.

Figure 4-1 provides a striking example of price risks, drawn from hog production. It displays the value of production (VOP), total costs, and net returns per hundredweight (cwt) for a representative independent feeder-to-finish producer from 1988 to 1998. Each series is adjusted for inflation and based on 1998 dollars. Price fluctuations drive almost all variation in the data—feed (corn and soybeans) and feeder pig prices drive costs, while changes in finished hog prices drive VOP fluctuations. The figure shows wide output price variability, from \$20 to \$100/cwt in 1998 dollars, with

Figure 4-1

### Output and input price risk in hog production

Value of Production, total costs, and net return (\$/cwt.)



Source: Value of production, total costs and net returns in 1998 from USDA ARMS. Estimates for other years computed using USDA NASS monthly price data (see Key, 2002 for details). All values are in 1998 dollars.

sharp short-term fluctuations. Output prices vary more than input prices, and hence are more important drivers of fluctuations in net returns. The income risk associated with independent production is dramatically illustrated in 1998, when a collapse in output prices resulted in net losses of nearly \$30/cwt by the end of the year.

Farmers have a variety of ways to reduce or cope with agricultural income risk (Harwood et al, 1999). Risk management strategies include purchasing crop or revenue insurance, using commodity futures markets, accumulating and depleting liquid assets (e.g., through grain storage or saving in financial markets), and borrowing. Producers can also reduce risk by diversifying production—choosing a mix of commodities or income sources (including off-farm employment)—or by altering their production practices (e.g., by irrigating, using more pesticides, or applying more fertilizer earlier in the season).

Contracting can also be a risk management strategy. While several factors likely influence decisions to contract, surveys of contracting farmers indicate that risk reduction plays an important role. For example, over half of contracting producers of grain in 1993-95 surveys rated cash-forward contracts as “effective” or “very effective” in providing price risk protection, while less than a third rated spot market sales as “effective” or “very effective” in doing so (Patrick, Musser, and Eckman, 1998). In their survey of hog producers, Lawrence and Grimes (2001) found that those with production contracts cited reduction in financial risks as a major advantage of contracts, as did those with marketing contracts. Finally, Lawrence, Schroeder, and Hayenga (2001) surveyed cattle and hog packers on the use of marketing contracts. Each group rated reduced price risk as an important contract motivation for producers. Interestingly, each group of packers rated improved and more consistent livestock quality as the most important advantages of contracts for packers.

## **How Can Contracts Reduce Risk?**

As we have seen, marketing contracts can reduce the income risks faced by growers through the terms specified in the contract’s pricing mechanism, but farmers must often still manage production risk. Depending on contract terms, production contracts can insulate farmers from most output price risks and many input price and yield risks. Table 4-1 summarizes our conclusions, discussed in more detail below.

### ***Marketing Contracts***

Under marketing contracts, producers usually bear all yield risk and frequently all input price risk. Some crop contracts, particularly those used for identity-preserved (IP) varieties, specify an (uncertain) amount grown on a particular area of land. Such “acreage contracts” shift some yield risk to the contractor; the producer still obtains revenue only from the amount delivered, but does not have to make up production shortfalls by buying in the cash market to fulfill contract terms. Some livestock contracts do specify a product price that depends in part on input prices, thereby mitigating some input price risk. Input price risk is particularly important in the livestock

**Table 4-1—How much of each source of risk do different types of contracts shift from growers to contractors?**

Contract type	Sources of risk			
	Price risk		Yield risk	
	Output	Input	Common	Idiosyncratic
<i>Amount of risk shifted from growers</i>				
<b>Marketing contracts:</b>				
<i>Flat price</i> - fixed certain price before harvest	Some or all, depending on share of expected output under contract	None	None	None
<i>Basis</i> - fixed difference from uncertain future price	Very little - only "basis" component of price risk	None	None	None
<b>Production contracts:</b>				
<i>Absolute performance</i> - for hogs/poultry, contractor provides almost all inputs except labor and facilities	Almost all	Almost all	Some - depends on contract incentives	Some - depends on contract incentives
<i>Relative performance</i> - same as for absolute performance except that fee is based on performance relative to other growers	Almost all	Almost all	Almost all	Little

Source: Authors' summary of text discussion on effect of contracts on risk.

sector, where feed costs constitute a large portion of the total input cost, and may be one reason why production contracts are more common in livestock production than with field crops.

Marketing contracts specify prices in several ways. For example, forward marketing contracts, frequently used in grain and livestock production, typically establish a base price and provide for the delivery of a given quantity of a good within a specified time. Prices may be modified with premiums and discounts for product attributes, such as moisture or oil content. A "flat price" version of a forward marketing contract sets a predetermined price for a particular quantity of a product before harvest. If growers are certain of their output, the flat price contract can eliminate all output price risk for that production period. On the other hand, if growers face yield risks, then a contract requiring growers to deliver a fixed quantity of a commodity may be risky. Farmers who do not harvest enough to meet contractual obligations may have to purchase the shortfall amount in the spot market. If the market price is higher than the contract price, then growers will lose money. Consequently, growers often find it advantageous to contract only a fraction of their expected output, and to sell any surplus in the cash market.

A “basis” version of a forward marketing contract determines price by applying a difference, or basis, to an uncertain expected price. Spatial differences in grain prices largely reflect transportation costs between production regions and destinations. For example, a farmer may agree to sell in October to a local elevator for 5 cents under the Chicago Board of Trade November futures price. A basis contract does not eliminate output price risk, but secures a market and basis for the grower, who can then hedge the price risk by using a futures contract, which is an agreement to trade a commodity with specified attributes at a specified future time (see Harwood et al, 1999 for a more thorough discussion). For example, by “short” hedging, a farmer sells futures contracts at some point prior to harvest, holds the futures contracts until harvest, then buys back the futures contract when the harvest is sold. In this way the loss (gain) in the value of the crop resulting from an unexpected change in the price is offset by the gain (loss) in the value of the futures contract. By selling a futures contract when entering into a basis contract (a marketing contract based on an uncertain future price), a farmer can eliminate most price risk. However, as with a fixed-price contract, hedging with futures contracts when yield is uncertain can add additional risk. Consequently, hedgers generally sell futures contracts equal to a fraction of the expected harvest.

Sellers of fed cattle or hogs often reach exclusive marketing agreements with a packer, with prices set through a predetermined pricing mechanism. In addition to guaranteeing a buyer for the farmer, the contract may reduce output price risk, depending on the pricing method. Livestock producers may incur risks resulting from their contractual obligations to deliver a predetermined number of animals to the contractor.

Producers of livestock, field crops, and fruits and vegetables sometimes use marketing pools in which groups of farmers commit specific quantities to an intermediary contractor, who then negotiates a price with downstream users on their behalf. Marketing pools can sometimes realize economies through consolidating production into larger lots, and pool operators offer specialized marketing expertise to reduce price risks through the use of marketing contracts, hedging strategies, and storage. Producers continue to bear yield risks if production falls below pool commitments or if pools are unable to market all of a farmer’s production.

### ***Production Contracts***

Like marketing contracts, production contracts can also shift production and input price risks from growers to contractors. Consider, for example, a production contract to feed, or finish, hogs until they reach slaughter weight. Growers provide labor and facilities and are paid a fee for raising the animals. The fee may have an incentive structure based on animal weight gain, death loss, or feed efficiency. With production contracts to finish hogs, the feed and other inputs supplied by the contractor typically represent over 80 percent of the total costs of production, and almost all input price risk is shifted to the contractor (McBride and Key, 2002). If grower compensation is not tied to the market price of the commodity, contractors also bear output price risks instead of growers.

Floriculture products are often grown under production contracts. A wholesale greenhouse firm, for example, may provide flowers and other nursery products to large retail chains and to independent nurseries (Higgins, 2003). The wholesaler ships seedlings to contract growers, specifies greenhouse design, and provides technical advice and a market outlet. Contracts call for farmers to pay the wholesaler a flat price for seedlings and to receive a flat price for flowers delivered 5 to 8 weeks later. Growers bear yield risk but forego price risk, and the contractor manages the system to time required product flows, which vary from week to week, to the needs of retail clients.

While a production contract can greatly reduce price risks for growers, they may still face varying degrees of production risk, depending on contract terms. If no incentives were included in the contract, and livestock growers were simply paid a fixed fee for raising animals, then the contract would eliminate all of the farmer's production risk. However, because this type of contract could create an incentive for growers to under-apply effort and care in raising the animals, most production contracts require farmers to share some portion of the production risk. Hog and poultry production contracts typically specify a base payment, in addition to bonuses that increase with feed efficiency (pounds of feed per pound of weight gain) and decrease with death losses. Production variation from animal weight gain and death loss would therefore raise or lower the fee the grower receives per head and reintroduce some grower production risk. Other production contracts bar the farmer from growing noncontract hogs, mitigating one incentive problem—that of diverting inputs—while imposing greater risks of asset specificity on the farmer.

## How Much Do Contracts Reduce Risk?

Few empirical analyses have estimated the effect of marketing contracts on growers' income risk. Since field crop contracts are almost exclusively marketing rather than production contracts, there is little direct information on risk reduction in crop contracts.

Several studies of livestock production contracts confirm that they can shift price and yield risk from growers to contractors. However, the extent to which they do so and the type of risk shifted depend on the contract terms and the incentive mechanisms. While contracts can reduce income risk, studies also indicate that growers may expect lower returns and may therefore pay a significant premium, in the form of foregone income, for lower risk.

In a study of poultry producers, Knoeber and Thurman (1995) found that price risks, in this case for inputs and output, were by far the most important components of income variability, representing 84 percent of total income variation. Common risks affecting all producers, as when the air temperature becomes very high, and idiosyncratic production risks affecting only a single producer, as when an automatic feeder breaks down, were much less important, each representing about 3 percent of total income variation.<sup>1</sup> Knoeber and Thurman then evaluated the effects of relative performance (or "tournament") contracts on risks and efficiency. As applied in poultry, a grower's fee depends on meat production *relative* to that of other contract growers who harvested at the same time, which in turn depends upon (high)

<sup>1</sup> These factors do not sum to one because the separate components of income risk co-vary.

feed conversion and (low) animal mortality, relative to peers, for a given allocation of young animals. Knoeber and Thurman found that the contracts shifted all price risk and about half of common production risk to the integrator who held the contract.

Four studies analyzed different dimensions of hog production contracts. Martin (1997) examined relative performance contracts using an approach similar to that of Knoeber and Thurman. Contracts again could sharply reduce risks—contract producers in Martin’s study faced only 10 percent of the income risk faced by independent producers. As in Knoeber and Thurman’s work, price risk was found to be the largest source of income risk by far, explaining 94 percent of the income variability. Moreover, relative performance contracts could shift as much as 94 percent of income risk to the integrator, depending on contract terms.

Johnson and Foster (1994) compared financial returns from independent hog production to those under four alternative contracts, and found that independents earned higher but more variable returns. Their study showed that a broad choice of contract terms allowed hog producers with different degrees of risk aversion to make tradeoffs between risk and returns. Similarly, Parcell and Langemeier (1997) estimated the contract payments that an independent farmer would need in order to accept a contract, depending on attitudes toward risk (level of risk aversion), grower profitability, and contract type. They found that more risk-averse growers were willing to accept lower base payments (a guaranteed fee per head) in contracts than less risk-averse growers (who were paid a base plus an incentive payment). Strongly risk-averse low-profit producers required only \$4.50/head to accept a contract, while slightly risk-averse high-profit producers required much more: \$28.50/head. The difference in required base payments between a slightly risk-averse and a strongly risk-averse average-profit producer was about \$8/head—an estimate of the value of risk reduction for a strongly risk-averse grower.

Many farmers assert that they much prefer the independence and managerial autonomy of operating in spot markets. In a survey by Lawrence and Grimes (2001), hog producers without contracts strongly agreed that they preferred to sell their hogs in spot markets. Key (2004) investigated the tradeoff that hog farmers make between the risk reduction offered by production under contract and the loss of autonomy. He found that a moderately risk-averse farmer would accept lower average prices for market hogs in exchange for lower risk. In his empirical work, Key estimated that the risk reduction offered through a typical production contract was worth about \$2.65/cwt to a moderately risk-averse farmer, which is about 5 percent of the historical average price for market hogs during the 1990s. If risk reduction were the only issue, we would expect contract producers to realize lower returns from hog production than independents. But Key found that contract grower returns exceeded returns realized by independent growers by more than \$3.68/cwt. He determined that the difference reflected the value of autonomy to producers. An implication of his work is that autonomy was highly valued—a moderately risk-averse producer in his analysis needed to be paid \$6.33/cwt, or 11.7 percent of the average market price, to give up autonomy.



## Risk Reduction Not the Whole Story

Empirical analyses of the effects of contracts on grower income risks are concentrated on livestock, particularly on hog and broiler production. We have very little evidence on the effects of contracts on income risks in cattle production and virtually none on crop production. The evidence we do have for livestock markets indicates that contracts can substantially reduce income risks associated with price and production variability, and contract terms can be calibrated to tailor the degree of risk reduction offered. Judging by what some producers are willing to pay for risk reduction in terms of lower returns, it appears to be quite valuable to them. Moreover, producers frequently cite risk reduction as a major benefit of production and marketing contracts (Lawrence and Grimes, 2001), and it is likely to be one important reason for contracting.

However, risk reduction is not necessarily the main reason for the spread of contracting, even in hog production where we have the most empirical evidence. Key (2004) used ARMS data to argue that the value of risk reduction to farmers is overstated if analyses do not control for the loss of autonomy many farmers experience under contract. Moreover, contracts can serve functions other than risk reduction; they can also improve efficiency in organizing production, easing the adoption of large-scale and specialized techniques and thereby reducing costs or improving product quality (Knoeber, 2000; Lawrence, Schroeder, and Hayenga, 2001; Hueth and Hennessy, 2002). We assess the evidence for that assertion in the next section.